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Business Level Data Disclosed Under FASB No. 14: Effective Use in Strategic Management Research

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Submitted to the Business Policy and Planning Division for 1989 Academy of Management National Meetings.

BUSINESS LEVEL DATA DISCLOSED UNDER FASB NO. 14: EFFECTIVE USE IN STRATEGIC MANAGEMENT RESEARCH

In response to the observed sub-optimal use of the Compustat II line-of-business database, we examine that database in the context of three issues critical to strategic management research: diversification, industry analysis, and vertical integration. Our analysis should help researchers protect the integrity of studies based on this increasingly popular database.

Research on multibusiness firms has long been hampered by the absence of firm-specific data aggregated at the line of business level. Thus, appearance of the COMPUSTAT II Line of Business database, which contains firms' disclosure of information required by FASB-SFAS No. 14, was heralded by strategic management and other researchers. This paper reports research on that data set of increasing importance to strategic management researchers. Using the line-of-business-level (or segment) data in COMPUSTAT II in the most effective manner for research is considered in the context of three issues critical in much strategic management research: 1) calculation of the related and unrelated components of diversification to assess the extent and type of diversification, 2) assessment of industry trends, and 3) evaluation of the presence of vertical integration.

Several trends have converged to necessitate attention to proper use of this data set. First, the availability of data disaggregated to the line of business level has enabled researchers to address interesting and important research questions for which appropriate data was previously unavailable in the public domain. Second, interest in diversification, acquisition, divestment and related topics has been high, consistent with greater incidence of those phenomena in the corporate world. As a result, researchers have approached this data set with enthusiasm. Attractive and useful as the data is, careful attention to its characteristics, understanding of its composition, and thus compensation for its limitations is necessary to protect the integrity of research using this data set and the value of such research results.

This paper briefly introduces and describes the nature of the database, discusses and illustrates certain common pitfalls researchers should avoid, and explains appropriate methods for correct use of this valuable data.

COMPOSITION OF THE COMPUSTAT II DATA SET

The COMPUSTAT line of business database is compiled from firms' annual reports and 10-K reports to the Securities and Exchange Commission (SEC). Disclosure of the financial information in this database is required by FASB-SFAS No. 14 "Financial Reporting for Segments of a Business Enterprise." This accounting standard defines a segment as: "A component of an enterprise engaged in providing a product or service, or a group of related products or services primarily to unaffiliated customers (i.e., customers outside the enterprise) for a profit." Since the institution of these segment reporting requirements, Standard and Poors' COMPUSTAT Service has been compiling the segment information of more than 6,000 publicly traded companies, including all companies traded on the NYSE, ASE and OTC, in the line of business database (COMPUSTAT II Line of Business Data).

FASB-SFAS 14 requires only that each company identify each of its segments by name. For the purposes of more detailed and comparable descriptions, COMPUSTAT (S&P personnel) assigns a maximum of two 4-digit SICs to each segment (SSIC1 and SSIC2). This further disaggregation of the data (identification of lines of business <u>within</u> the FASB-required segments) has been viewed favorably (and correctly

so) by researchers interested in business-level strategic issues. However, herein lies the potential for misuse and abuse of this database, which may lead to erroneous research results.

First, it is important to note that COMPUSTAT (Standard and Poors, not the companies) identifies the businesses by SIC codes (SSIC's). It is reasonable to assume that COMPUSTAT's SSIC code assignments are carefully and consistently executed. The COMPUSTAT II Line of Business Manual explains that "SSICs are based on the activites of the segments as described by the company in its annual report or 10-K. The first SIC should be considered the primary SIC of the segment....SPCS will attempt to assign two SIC codes, for each industry segment." (COMPUSTAT II Section 5-A, p.26). It is important to recognize, however, that distance between SSIC codes of businesses within a segment should not be viewed as unrelatedness of those businesses; the company has indicated that such businesses belong to "a group of related products or services" (FASB segment definition, above) by joining them in a segment.

Second, it is important to understand the second SSIC code for each segment and the relationship between the two lines of business per segment as identified by COMPUSTAT. Some previous researchers have treated the lines of businesses within segments as separable (allowing the presence of different SSIC codes to override the fact that the two lines of business are housed by the firm in the same segment). For some research questions, such separation of segment lines of businesses may be correct, but for many questions of importance to strategic management (type of diversification, extent of vertical integration),

such separation would be a serious error. As noted above, the companies provide descriptions of their lines of business (on which COMPUSTAT bases its SSIC assignments) in annual reports and 10K's, and they assert relatedness among some lines of business through grouping certain businesses together as a segment (see FASB segment definition above).

Thus, we argue that the second SIC code (SSIC2) may be assumed to denote an activity related to the manufacture or service of the activity in the primary SIC (SSIC1). Support for this assumption is based on the fact that a segment comprises of "a component of an enterprise engaged in providing . . . a group of related products or sevices to unaffiliated customers . . ." (COMPUSTAT II Section 2, p.2). Within-company sales do not comply with the requirement of selling to "unaffiliated customers." Therefore, by definition, vertical or horizontal integration activity has to be assigned to the segment of the end product.

The Compustat documentation refers to yet another level of disaggregation, the PSIC (product SIC), but researcher should note that PSICs are also assigned by S&P, disclosure by firms at that further level of disaggregation is not required by law. Thus, the PSIC data are quite spotty and of questionable consistency and accuracy.

USING COMPUSTAT DATA IN VERTICAL INTEGRATION RESEARCH

Because the assumption of relatedness within firms' segments is critical to the contribution of this paper, we conducted an analysis of

the line of business database to determine whether further support for the assumption existed. The procedures and results of that analysis will be described next.

In our analysis, we compared SSIC1 and SSIC2 for all segments in the database for the years 1979-85 (availability of COMPUSTAT II data begins with 1979). Tables 1 and 2 illustrate the crosstabulation between SSIC1 and SSIC2 at the 2-digit and 3-digit levels, respectively. As shown, 30.5% of the segments had h

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Insert Tables 1 and 2 about here

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only a primary SIC (SSIC2 was 0 -- COMPUSTAT assigns a maximum of two SIC codes per segment). As that 30.5% are single-business segments, they are not central to this paper. It is reasonable to assume some sort of relatedness for two other groups which emerged from the data: segments with both the primary and secondary businesses (SSIC1 and SSIC2) in the same 3-digit SIC (10% of all segments) and the 28% of all segments with both SSIC1 and SSIC2 in the same 2-digit SIC. (It is interesting to note that when the SIC match is relaxed from the 3-digit level to the 2-digit level, the proportion of segments with both businesses in the same SIC increases from 10% to 28%.)

We then further examined the 41.8% of all segments whose primary and secondary businesses did not fall in at least the same 2-digit SIC. Erroneous classification of a segment's businesses as unrelated seemed most likely to occur within this (fairly large) group. We examined the data for vertical integration relationships within firms' segments, as

FASB reporting requirements specify that segments must be formed such that they provide "products or services to unaffiliated customers" (thus any vertical or horizontal integration the firm engages in must be housed within segments).

Vertical integration in a segment may be of two types. One type occurs in instances such as those where metallic ore extraction and metal manufacturing are in the same segment, or where petroleum extraction and petroleum wholesale distribution are in the same segment. The other type of vertical integration occurs when a segment includes activities where manufacturing output from one 2-digit SIC becomes input for manufacturing in a different 2-digit SIC. This would be the case for a segment identified by SSIC 2200 (textile mill products) and SIC 2330 (women's apparel).

The first type of vertical integration is relatively simple to discern. Identification of vertical integration in a segment is made when one of the SSIC is in raw material (SIC 0100 - 1999), manufacturing (SIC 2000 - 3999), or service (SIC 4000 - 9999), while the other SSIC belongs to one of the other two areas; it may be assumed that the two businesses' presence in the same segment is an indication of vertical integration. For instance, a segment having SSIC1-2020 and SSIC2-5143 is forward integrated, because SIC-2020, the primary SIC, is the manufacture of dairy products and SIC-5143, the secondary SIC, is the wholesale of dairy products. Our analysis, summarized in Table 3, indicates that for at least 36% of the segments in question (15% of the total number of segments), the primary and secondary businesses were related by this first type of vertical integration.

Insert Table 3 about here

The second method of establishing vertical integration is more complex. For the remaining 26.5% of segments (those for which SSIC1 and SSIC2 were not in the same 2-digit SIC and were not in adjacent industry stages), both the primary and secondary businesses were in raw materials, manufacturing or service. A random check of these segments showed that a significant proportion of even these segments (85% of those checked) had some related integrated activity, upstream or downstream. For example, a segment with SSICs 3721 and 3664 might appear to consist of unrelated manufacturing activity, if one looks only at similarity of SSICs. Yet, closer inspection reveals the firm's logic in assigning these activities to a single segment: SIC-3721 is aircraft manufacturing and SIC-3664 is the manufacture of search, detection, navigation and guidance sytems and equipment. Activity in SIC-3664 provides critical instrumentation used in all types of aircraft, especially defense aircraft, thus this segment contains vertically integrated, not unrelated, businesses.

Research on vertical integration that raises questions about the type or extent of vertical integration in certain industries can thus make use of COMPUSTAT line-of-business data very effectively. The above analysis has reconfirmed that activity reported by firms as being associated with a single product or group of related products is indeed so despite the fact that the varied SSICs within segments can give the appearance of unrelated businesses. To recapitulate the findings from

Tables 1 and 2, an analysis of all 6,007 firms on the COMPUSTAT II line-of-business database: 58% of segments had SSIC1 and SSIC2 in the same 2-digit code, and nearly half of the remaining 42% were vertically integrated segments with SSIC1 as the primary activity of the segment. Therefore, a segment is best described by the primary SIC of the segment (SSIC1) at the two digit level. Splitting a firm's segments into the two SSICs assigned to each, and treating them as separable businesses, as has been done in some studies, inappropriately increases the measure of strategic diversity of that firm's activity.

USE OF COMPUSTAT DATA IN INDUSTRY ANALYSIS

COMPUSTAT II data lends itself to the calculation of industry trends, with respect to strategic diversity, vertical integration, and many other issues. This is especially useful when research questions require that industry trends be studied in conjuction with firms' data, or with firms disaggregated at the segment level, as compatability of databases is a critical consideration in such instances.

In past studies requiring industry level information, data from the Census of Manufacturers were most commonly used. However, this data has limitations which render it inappropriate for use in conjunction with COMPUSTAT line of business data. First, the Census cautions that the value of shipments is not accurate at the 3-digit and 2-digit levels (Comments on Statistical Measures and Tables, nos 18, 19, Census of Manufacturers, 1982):

"Multiunit companies were instructed to report for each establishment as if it were a separate economic unit and, in particular to report interplant transfers at their full economic value." (page xxi)

"The aggregates of the cost of materials and value of shipments figures for industry groups and all manufacturing industries includes large amounts of duplication since the products of some industries are used as materials by others. . . . . Because the amount of duplication of the cost of materials in the value of products figures cannot be measured with any degree of precision, caution is urged with the use of the value of shipments total at the two- and three-digit industry group levels." (page xxiii)

By contrast, Compustat data is more effective at these levels.

A second limitation of Census of Manufacturers data is that the census is conducted only every five years (1977, 1982, 1987). Data for the intervening years are estimated by surveying a sample of one-fourth of the population. Of the years covered by COMPUSTAT line-of-business database (1978-86), only 1982 is a census year; data for all other years in that period are estimates.

Yet another limitation is that the Census of Manufacturers covers only firms in the SIC range 2000-3999, and does not provide comparable data for non-manufacturing activities in SICs 0100-1999 and 4000-9999. Data is available on those SIC groups, but from a variety of sources

(Census of Mining, Census of Agriculture, etc.), thus comparability of definitions and of time periods cannot be assumed.

Using the COMPUSTAT II line-of-business data aggregated to the industry level can overcome many of the Census data problems. Among the advantages of COMPUSTAT II are that data are reported annually for all firms in the database, that data are readily available online, that duplication (double-counting of sales) as found in the Census data is avoided, and that trends at the business, firm and industry levels can be studied with confidence that the variables' definitions are the same at all levels.

The major limitation on use of COMPUSTAT II line-of-business data for industry analysis is that the database includes only the companies traded on the NYSE, ASE and OTC exchange (6,007 firms) while the Census of Manufacturing covers more than 220,000 public and private firms. However, if industry constructs are operationalized as trends rather than as absolutes, the impact of COMPUSTAT's limited company coverage, 6,007 firms from the total population, is minimized if not eliminated. In addition, it should be pointed out that the population of publicly traded companies, of which COMPUSTAT II is composed, represents almost all the large U.S. firms, and those in turn represent a significant proportion of the output of U.S. business enterprise. (The Census of Manufacturers has estimated that the 200 largest manufacturing firms account for 43% of value added by manufacture. Therefore, 6,007 of the largest firms certainly represent the greater proportion of output compared to those companies not included.) If research questions under consideration are such that the firms studied are from the Fortune 500,

the proportion of industry membership represented among 6,007 of the largest firms could be safely assumed to constitute the relevant industry referent groups for those firms.

A limitation of privately generated databases, including S&P's Compustat Industry Aggregate database and S&P Financial Dynamics' Industry Composites, is that these data are based on annually-reported firm-level data. In contrast to Compustat II's line-of-business data most such industry data is not developed by separating firms into their diversified segments and therefore, risks inaccuracy by misattributing a firm's entire data to its primary industry affiliation.

There appear to be systematic biases in both the Census of Manufacturers and the COMPUSTAT II databases: the Census data with respect to duplication of shipments and 5 year data collection frequency the COMPUSTAT data with respect to more limited company coverage. Researchers choosing one database or the other may also be interested to know that industry growth rates calculated from COMPUSTAT (as measured by change in sales) and from the Census of Manufacturers (as measured by change in the value of shipments) showed a high degree of correlation (more than 0.70, significant at the .001 level).

USE OF COMPUSTAT DATA TO STUDY BUSINESS RELATEDNESS

The segment SICs in the COMPUSTAT line of business database can be effectively and efficiently utilized to evaluate "relatedness" in firms' diversification strategies. Rumelt (1974) and many researchers following him have used methods that differentiate between related and

unrelated diversification in categoric terms. Berry (1974), Jacquemin and Berry (1979), Montgomery (1982), and Palepu (1985) have all used continuous measures or indices to evaluate total diversification, without comparing related and unrelated diversifiers. Berry (1974) and Montgomery (1982) used a variant of the Herfindahl index of industry concentration to measure firms' total diversification. Jacquemin and Berry (1979) developed an entropy-based measure of diversification, later used by Palepu (1985). The entropy measure used by these researchers measured total diversification (DT) as the sum of two indices (DR + DU), such that DT (total diversification) = DR (related diversification) + DU (unrelated diversification).

The COMPUSTAT line of business database lends itself to measuring relatedness by any of these methods. However, as discussed at some length in a preceding section of this paper, segments should be kept intact by researchers addressing many of these questions, even if the SSICs differ greatly. (The firm has already defined a segment as comprising of related activities, therefore, it would be erroneous for researchers to split up segments.) For purposes of the Herfindahl and entropy index measures, SSIC1 should be considered as the primary SIC of the segment in accordance with the recommendation of S&P's COMPUSTAT II documentation. Table 4 shows the indices for total diversification (DT, DR and DU) produced by each of these methods using COMPUSTAT line of business data for three firms, as well as categoric classifications (Rumelt, 1974) for the same firms.

Insert Table 4 about here

(Segment SICs, segment names (descriptive) and other information are often used as the basis for calculating the related, specialization and vertical ratios for these categoric classification).

Researchers in strategic management are concerned with evaluating both extent and type of firms' diversification. The diversification measures outlined above address either extent or type, but not both. For example, Table 4 shows that the entropy index value for Honeywell and American Home Products, Inc., are very close in value, 1.36 and 1.31, respectively. However, it is also clear that these values do not satisfactorily express the difference in type of diversification in these companies.

We argue that a variant of the entropy measure could address both of these needs. We suggest an index of type of diversification which takes into consideration the difference between DU and DR. The following illustration will show the power of this simple variant of the entropy measure in depicting type of diversification. Calculating DD (difference in diversification types) as DD = DU - DR, a researcher is then able to observe that a negative value of DD signifies a greater level of related diversification, while a positive value of DD signifies a greater level of unrelated diversification, and values around zero suggest a balance between related and unrelated diversification. The values for DD shown in Table 4 suggest that American Home Products has a high level of related diversification while Honeywell is evenly balanced between unrelated and related, and ITT's high level of unrelated diversification is clearly evident. We

therefore argue that while DT does provide a measure of the extent of strategic diversity in firms, DD provides a much-needed measure of the type of diversification involved. The DD measure should be used instead of DT when type of diversification is the research issue, and together with DT (perhaps combined into an index) when both type and extent of diversification are of research interest. Use of the DD measure can help overcome the problem of large within-group variations, which are characteristic of methods employing group classification schema.

Researchers studying dynamic aspects of diversification would benefit from using our DD-DT measure, as these continuous measures are more sensitive to changes in strategic diversity than are broad categoric classifications. Finally, the DD-DT measures can be more readily replicated by researchers than can subjective categoric classifications.

CONCLUSION

We have considered the use of line-of-business data for three issues of significant interest to strategic management practitioners and researchers: assessment of strategic diversity, analysis of industry trends, and evaluation of the presence of vertical integration. Based on the analysis reported in this paper, we conclude (1) that the Compustat II line-of-business database provides an efficient and effective source of data for such questions, but (2) that certain caveats apply to use of that data and must be observed to avoid

erroneous research results. A summary of those uses and caveats follow.

First, for such questions as measurement of diversity, a segment should not be considered to comprise of two unrelated components, despite the presence of two seemingly diverse segment SICs, because the firm has already declared some relatedness through their segmentation. With this caveat observed, the database can be quite effectively used to calculate Herfindahl, entropy and other measures.

Second, we find Compustat II line-of-business to be quite satisfactory for the study of industry trends, assuming the above caveat is observed. With increasing proportion of industry output originating from highly diversified firms, accurate data for industry-level questions has been difficult to obtain. The drawbacks of Census data were discussed above, as were those of currently available industry aggregate data from private services. Compustat II provides readily accessible data, disaggregated from diversified firms to the business level, which can then be re-aggregated by industry.

Third, Compustat II is an unexploited resource for research on vertical integration. As explained in this paper, with proper use of this data set, researchers can detect vertical integration not only within firms but also within segments of firms.

Researcher observing the restrictions and recommendations outlined in this paper for proper use of the Compustat II data set can proceed with greater confidence to use Compustat II to address important research questions for which appropriate data were previously unavailable.

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TABLE 1

Cross-tabulation of SSIC1 & SSIC2 (2-digit) by Year

V1	COUNT / COL PCT	YEAR 78	79	80	81	82	83	84	ROW TOTAL
SSIC2 EQ SSIC1	1	2315	2413	2528	2616	2716	2794	2232	17614
		27.8	28.1	28.1	28.0	27.3	27.0	28.2	27.8
SSIC2 EQ 0	2	2685	2640	2707	2804	3024	3145	2331	19336
		32.3	30.7	30.1	30.0	30.4	30.4	29.5	30.5
SSIC2 NE SSIC1 0	3	3317	3538	3762	3938	4206	4402	3351	26514
		39.9	41.2	41.8	42.1	42.3	42.6	42.3	41.8
	COLUMN TOTAL	8317	8591	8997	9358	9946	10341	7914	63464
		13.1	13.5	14.2	14.7	15.7	16.3	12.5	100.0

TABLE 2

Cross-tabulation of SSIC1 & SSIC2 (3-digit) by Year

V1	COUNT / COL PCT	YEAR 78	79	80	81	82	83	84	ROW TOTAL
SSIC2 EQ SSIC1	1	812	859	907	946	979	1019	805	6327
		9.8	10.0	10.1	10.1	9.8	9.9	10.2	10.0
SSIC2 EQ 0	2	2685	2640	2707	2804	3024	3145	2331	19336
		32.3	30.7	30.1	30.0	30.4	30.4	29.5	30.5
SSIC2 NE SSIC1 0	3	4820	5092	5383	5608	5943	6177	4778	37801
		58.0	59.3	59.8	59.9	59.8	59.7	60.4	59.6
	COLUMN TOTAL	8317	8591	8997	9358	9946	10341	7914	63464
		13.1	13.5	14.2	14.7	15.7	16.3	12.5	100.0

TABLE 3

Cross-tabulation of Segments' Industry Stages by Year

V2	COUNT / COL PCT	YEAR 78	79	80	81	82	83	84	ROW TOTAL
1		501	542	594	624	694	736	549	4240
MANU. WT SERVICE		6.0	6.3	6.6	6.7	7.0	7.1	6.9	6.7
2		104	100	95	104	99	101	87	690
MANU. WT MINING		1.3	1.2	1.1	1.1	1.0	1.0	1.1	1.1
3		1190	1250	1288	1311	1347	1382	1110	8878
MANU. WT MANU.		14.3	14.6	14.3	14.0	13.5	13.4	14.0	14.0
4		154	176	219	263	281	293	195	1581
MINING WT SERVIC		1.9	2.0	2.4	2.8	2.8	2.8	2.5	2.5
5		72	70	70	67	69	70	48	466
MINING WT MINING		.9	.8	.8	.7	.7	.7	.6	.7
6		73	80	83	70	69	70	53	498
MINING WT MANU.		.9	.9	.9	.7	.7	.7	.7	.8
7		901	972	1039	1099	1214	1297	982	7504
SERVICE WT SERVI		10.8	11.3	11.5	11.7	12.2	12.5	12.4	11.8
8		151	171	190	204	209	224	162	1311
SERVICE WT MININ		1.8	2.0	2.1	2.2	2.1	2.2	2.0	2.1
9		171	177	184	196	224	229	165	1346
SERVICE WT MANU.		2.1	2.1	2.0	2.1	2.3	2.2	2.1	2.1
10		5000	5053	5235	5420	5740	5939	4563	36950
SSIC2 EQ SSIC1 0		60.1	58.8	58.2	57.9	57.7	57.4	57.7	58.2
COLUMN TOTAL		8317	8591	8997	9358	9946	10341	7914	63464
		13.1	13.5	14.2	14.7	15.7	16.3	12.5	100.0

TABLE 4

Entropy Measures of Selected Firms

Co. Name	S SIC	Seg Sales / Tot Sales	Gp Sales / Tot Sales	DU	DR	DT (DU+DR)	DD (DU-DR)	Categoric Class.
Am. Home	2834	39.7						
Prod.,	2834	13.3						
	2842	27.0	80.0					
	2032	20.0	20.0	.69	.67	1.36	.02	R
Honeywell	3822	24.1						
	3823	21.7	45.8					
	3664	19.7						
	3680	34.5	54.2	.50	.81	1.31	-.31	R
ITT	3661	32.6						
	3663	4.3						
	3679	6.0						
	3651	6.0	48.9					
	3823	16.5	16.5					
	2051	11.2	11.2					
	7011	6.4	6.4					
	2611	6.8	6.8					
	3714	10.1	10.1	1.48	.49	1.97	.99	U

R - related diversification
U - unrelated diversification

DU, an index value of unrelated diversification, is the weighted average of all group shares across which the firm participates. Each group gets a weight equal to its share in the total operations of the firm, ie., [(gp. sales/tot. sales) * ln(tot. sales/gp.sales)]

DR, an index value of related diversification, is a similar weighted average of the related diversification across segments within all industry groups in which the firm participates.